ample provisions for Strasburg, utterly neglected the university system of the country, and failed to introduce the uniformity of management and many other reforms, the need of which is painfully felt since the formation of a united Germany. Prof. Sachs, the well-known botanist, has been raised into the nobility, possibly in recognition of his refusal of a flattering call to Berlin.

HANOVER AND AIX-LA-CHAPELLE.—The two large polytechnics in these cities show a striking diminution in point of attendance during the past year, a fact which would seem to show that the various technical branches in Germany are being overcrowded. Hanover is attended at present by 725 students and the instructors number 46. Aix-la-Chapelle has suffered a reduction of 200 students in comparison with 1876.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 17.—"New Determination of the Mechanical Equivalent of Heat," by J. P. Joule, LL.D., F.R.S. An account is given by the author, of the experiments he has recently made, with a view to increase the accuracy of the results given in his former paper, published in the *Philosophical Transactions* for 1850. The result he has now arrived at, from the thermal effects of the friction of water, is, that taking the unit of heat as that which can raise a pound of water, weighed *in vacuo*, from 60° to 61° of the mercurial thermometer; its mechanical equivalent, reduced to the sea-level at the latitude of Greenwich, is 772·55 foot-pounds.

February 7.—"On the Comparison of the Standard Barometers of the Royal Observatory, Greenwich, and the Kew Observatory," by G. M. Whipple, B.Sc., F.R.A.S., Superintendent of the Kew Observatory.

Owing to certain statements having been circulated as to a large difference existing between the standard barometers of the above two chief meteorological establishments in this country, the Kew Committee decided to institute a direct comparison between them, by the conveyance of a number of instruments to and fro, several times between the two observatories.

The author accordingly did this, having made three extended experiments of this nature, details of which are given in the paper, the results being as follows:—

Mean difference from—

1st series of	128	comparisons—Greenwich-Kew	= + 0·0016 inch.
2nd ,,	144	,, ,, ,,	= + 0·0007 ,,
3rd ,,	72	,, ,, ,,	= + 0·0014 ,,
Final mean of	344	,, ,, ,,	= + 0·0012 ,,

Certain experiments were also made to determine the necessary corrections to be applied to the Greenwich barometer on account of inequality of distribution of temperature around it. When these corrections are applied the difference between the two standards is reduced to 0·0001 inch, that is to say, the two instruments virtually agree.

In conclusion the author tenders his thanks to the Astronomer-Royal, for the facilities he afforded for the prosecution of the experiments, and to Messrs. Ellis and Nash for assistance they rendered.

Geological Society, January 23.—Prof. P. Martin Duncan, F.R.S., president, in the chair.—J. Eunson, C.E., R. C. Forster, Walter Mawer, Richard H. Solly, and the Rev. Arthur Watts, were elected Fellows of the Society. The following communication was read:—On the secondary rocks of Scotland.—Part III. The strata of the Western Coast and Islands, by John W. Judd, F.R.S., F.G.S., Professor of Geology in the Royal School of Mines. The existence of scattered patches of fossiliferous strata, lying between the old gneissic rocks and the masses of tertiary lava in the Hebrides, has been known to geologists for more than a century. By Dr. Maculloch, who did so much for the elucidation of the interesting district in which they occur, these strata were referred to the lias; but Sir Roderick Murchison showed that several members of the oolitic series were also represented among them. Later researches have added much to our knowledge of the more accessible of these isolated patches of Jurassic rocks in the Western Highlands. During the seven years in which he has been engaged in the study of these interesting deposits, the author of the present memoir has been able to prove that not only is the Jurassic system very completely represented in the Western Highlands, but that associated with it are other deposits representing the carboniferous, poikilitic (permian and trias), and cretaceous deposits, the existence of which in this area had not hitherto been suspected; and by piecing together all the fragments of evidence, he is enabled to show that they belong to a great series of formations, of which the total maximum thickness could have been little, if anything, short of a mile. The relations of the scattered patches of mesozoic strata to the older and newer formations respectively, are of the most interesting and often startling character. Sometimes the secondary rocks are found to have been let down by faults, which have placed them thousands of feet below their original situations in the midst of more ancient masses of much harder character. More usually they are found to be buried under many hundreds, or even thousands, of feet of tertiary lavas, or are seen to have been caught up and inclosed between great intrusive rock-masses belonging to the same period as the superincumbent volcanic rocks. Occasionally the only evidence which can be obtained concerning them is derived from fragments originally torn from the sides of tertiary volcanic vents, and now found buried in the ruined cinder-cones which mark the sites of those vents. In some cases the mineral characters of the strata have been greatly altered, while their fossils have been occasionally wholly obliterated by the action of these same igneous forces during tertiary times. In every case the survival to the present day of the patches of secondary rocks can be shown to be due to a combination of most remarkable accidents; and a study of the distribution of the fragments shows that the formations to which they belong originally covered an area having a length of 120 miles from north to south, and a breadth of fifty miles from east to west. But it is impossible to doubt the former continuity of these secondary deposits of the Hebrides with those of Sutherland to the north-east, with those of Antrim to the south, and with those of England to the south-east. From the present positions of the isolated fragments of the mesozoic rocks, and after a careful study of the causes to which they have owed their escape from total removal by denudation, the author concludes that the greater portion of the British Islands must have once been covered with thousands of feet of secondary deposits. Hence it appears that an enormous amount of denudation has gone on in the Highlands during tertiary times, and that the present features of the area must have been, speaking geologically, of comparatively recent production—most of them, indeed, appearing to be referable to the pliocene epoch. The alternation of estuarine with marine conditions, which had, on a former occasion, been proved to constitute so marked a feature in the Jurassic deposits of the Eastern Highlands is now shown to be almost equally striking in the Western area; and it is moreover pointed out that the same evidence of the proximity of an old shore-line is exhibited by the series of cretaceous strata in the west. The succession and relations to one another of the series of deposits, now described as occurring in the Western Highlands, is given in the following table:—

Miocene Volcanic and Intervolcanic Rocks.

UNCONFORMITY.

			Maximum thicknesses. feet.
Cretaceous.	1.	Estuarine clays and sands with coal	20 +
	2.	White chalk with flints (zone of *Belemnitella mucronata*)	10 +
	3.	Estuarine sandstones with coal	100
	4.	Upper greensand beds	60

UNCONFORMITY.

Jurassic.	5.	Oxford clay	?
	6.	Great estuarine series	1000
	7.	Lower oolite	400
	8.	Upper lias	100
	9.	Middle lias	500
	10.	Lower lias	400
	11.	Infralias	200
	12.	Poikilitic	1000 +

UNCONFORMITY?

Carboniferous strata (coal-measures).

UNCONFORMITY.

Old Gneiss Series and Torridon Sandstones.

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Although no traces of the upper oolite or the neocomian formations have as yet been detected in the Western Highlands, yet it is argued that when we consider how enormous has been the amount of denudation, and how singular the accidents to which all the existing relics of the secondary period have owed their escape from total destruction, we cannot but regard it as a most rash and unwarrantable inference to conclude that no deposits belonging to those periods were ever accumulated within the district under consideration. The carboniferous strata of the Western Highlands have been detected at but a single locality; and even there, being exposed in a series of shore reefs that are only occasionally well displayed, can only be studied under favourable conditions of tide and wind. They consist of sandstones and shales with thin coaly seams, and their age is placed beyond question by the discovery in them of many well-known plants of the coal-measures, including species of *Lepidodendron*, *Calamites*, *Sigillaria*, and *Stigmaria*. The poikilitic strata consist of conglomerates and breccias at the base, graduating upwards into red marls and variegated sandstone, which contain concretionary limestones and occasional bands of gypsum. These strata have not as yet, like their equivalents in the Eastern Highlands (the reptiliferous sandstone of Elgin and the Stotfield rock) yielded any vertebrate remains. They were evidently deposited under similar conditions with the beds of the same age in England, and are not improbably of lacustrine origin. The Jurassic series presents many features of very great interest. The infralias is better developed than is perhaps the case in any part of the British Islands; and in the district of Applecross a series of estuarine beds, containing thin coal-seams, is found to be intercalated with the marine strata. The lower lias, in its southern exposures, presents the most striking agreement with the equivalent strata in England, but when traced northwards exhibits evidence of having been deposited under more littoral conditions; the lower division (lias α, Quenstedt) is represented by a great thickness of strata; while the upper (lias β) is absent or rudimentary. The middle lias is grandly developed, and consists of a lower argillaceous member and an upper arenaceous one, the united thickness of which is not less than 500 feet. The upper lias singularly resembles in the succession of its beds, and its palæontological characters, the same formation in England. The inferior oolite is formed by series of strata varying greatly in character within short distances, and betraying sufficient signs of having been accumulated under shallow-water conditions. Above the inferior oolite we find a grand series of estuarine strata, partly arenaceous and partly calcareo-argillaceous; and this is in turn covered conformably by an unknown thickness of blue clays with marine fossils of middle Oxfordian age. At the very lowest estimate, the Jurassic series of the Western Highlands could not have had a thickness of less than 3,000 feet! The cretaceous strata of the Western Highlands, though of no great thickness, are of surpassing interest. They consist of two marine series alternating with two others of estuarine origin. At the base we find marine deposits of upper greensand age, strikingly similar to those of Antrim, but in places passing into conglomerates along old shore lines. Above the upper greensand beds occur unfossiliferous sandstones, in which thin coal-seams have been detected, and these are in turn covered by strata of chalk, converted into a siliceous rock, but still retaining in its casts of fossils (*Belemnitella*, *Inoceramus*, *Spondylus*, &c.), and in its beautifully preserved microscopic organisms (*Foraminifera*, *Xanthidia*, &c.) unmistakable proofs of its age and the conditions of its deposition. Above this representative of the highest member of the English chalk there occur argillaceous strata with coal-seams and plant-remains which are perhaps the equivalent of younger members of the cretaceous series, not elsewhere found in our islands, or, it may be, they must be regarded as belonging to periods intermediate between the cretaceous and tertiary epochs. It is greatly to be regretted that these cretaceous deposits of the Western Highlands are so unfavourably displayed for our study as to present scarcely any facilities for the collection of their fossils; for these, if found, might be expected to throw a flood of light on some of the most obscure palæontological problems of the present day. Although the comparison and correlation of the secondary strata of the Highlands with those of other areas, and the discussion of the questions of ancient physical geography thereby suggested, are reserved for the fourth and concluding part of his memoir, the author takes the opportunity of making reference, in bringing the present section of his work to a close, to several problems on which the phenomena now described appear to throw important light. In opposition to a recent speculation which would bring into actual continuity the present bed of the Atlantic and the old chalk strata of our island, he points to the estuarine strata of the Hebrides as demonstrating the presence of land in that area during the cretaceous epoch. He also remarks on the singular agreement of the conditions of deposition of both the silurian and cretaceous strata of the Scottish Highlands and those of the North American continent. But he more especially insists on the proofs, which we now have, that the Highlands of Scotland, as well as the greater part of the remainder of the British Islands, were once covered by great deposits of secondary strata, and that the area has been subjected to enormous and oft-repeated denudation. He dwells on the evidence of the vast quantities of material which have been removed subsequently to the mesozoic and even to the miocene period, and he maintains the conclusion that many, if not all, of the great surface-features of the highlands must have been produced during the very latest division of the tertiary epoch, namely the pliocene.

Mathematical Society, February 14.—Lord Rayleigh, F.R.S., president, and subsequently Mr. C. W. Merrifield, F.R.S. vice-president, in the chair.—The following communications were made:—On a general method of solving partial differential equations, Prof. Lloyd Tanner.—On the conditions for steady motion of a fluid, Prof. Lamb (Adelaide), (particular cases of the conditions were given by Stokes in the Cambridge *Phil. Trans.* for 1842).—On a property of a four-piece linkage and on a curious locus in linkages, Mr. A. B. Kempe.—On Robert Flower's new mode of computing logarithms (1771), Mr. S. M. Drach.—On the Pluckerian characteristics of the modular equations, Prof. H. J. S. Smith, vice-president, F.R.S.—Mr. Drach also exhibited drawings of tricircloids made some thirty years since for Mr. Perigal.

Royal Microscopical Society, February 6.—Anniversary.—H. C. Sorby, president, in the chair.—The report of the Treasurer was submitted to the meeting.—The report of the Council stated that the library and instruments of the Society were in a satisfactory condition, and obituary notices of deceased Fellows, Dr. Bowerbank and Dr. Henry Lawson, were read by the Secretary. Messrs. Glaisher and Curties having been appointed scrutineers, a ballot for officers and council for the ensuing year took place with the following result:—President, H. J. Slack; Vice-presidents, Dr. L. S. Beale, Dr. C. T. Hudson, Sir John Lubbock, Bart., and Mr. H. C. Sorby; Treasurer, Mr. J. W. Stephenson; Secretaries, Mr. Chas. Stewart and Mr. Frank Crisp; Council, Mr. John Badcock, Mr. W. A. Bevington, Dr. R. Braithwaite, Mr. Chas. Brooke, Mr. C. J. Fox, Dr. W. J. Gray, Mr. E. W. Jones, Dr. Matthews, Mr. S. J. McIntire, Dr. John Millar, Mr. Thos. Palmer, and Mr. F. H. Ward; Assistant-secretary, Mr. Walter W. Reeves. The retiring president then delivered his annual address, which chiefly treated of the results of his investigations into a method of obtaining the refractive indices of minerals.

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